Smooth Dogfish (*Mustelus canis*) Fin-to-Carcass Ratio Project

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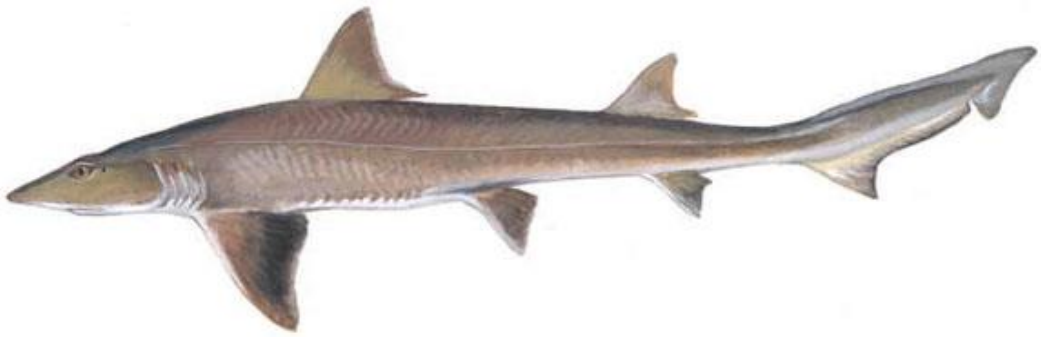

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ABSTRACT

The cumulative data on 77 smoothhound sharks (*Mustelus canis,* smooth dogfish) analyzed in this paper indicate that an appropriate fin-to-carcass ratio for smooth dogfish, based on current commercial processing methods, can range from 8-to-98, excluding the second dorsal and caudal fin, to 14-to-86, including the second dorsal and caudal fin. The data presented are from fishery independent and dependent sampling, with a male-to-female sex ratio of 50-to-27 (65% male, 35% female). Mean fork length of the fish sampled is 766.7 mm., ranging from 545 to 1110 mm. The mean percent fin weight for fin sets including the caudal is 13.94%. When the fin set excludes the caudal fin but includes the second dorsal fin, the mean percent fin weight is 8.93%. If the fin set contains only the first dorsal and the pectoral fin, the mean percent fin weight is 7.76%. Studies conducted by New Jersey and North Carolina collected individual fork length (mm.), sex (m/f), round/whole weight (kg.), dressed/carcass weight (kg.), first dorsal weight (kg.), second dorsal weight (kg.), pectoral fin weight (kg.) and caudal fin weight (kg.) for each fish. Total fin weights and percent carcass weights were then calculated for each individual fish. This paper presents the most robust sample size of smooth dogfish, to date, for the analysis of a species specific smooth dogfish ratio. The data show no relationship between the fin-to-carcass ratio and the fork length or dressed carcass weight of the fish. This paper presents data that can be used to determine a species specific smooth dogfish fin-to-carcass ratio, depending on the fin sets retained.

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INTRODUCTION

The smooth dogfish fin-to-carcass ratio and processing at sea has been a contentious topic between user groups, the public and managers for many years. To date there are no published studies that determine a species specific fin-to-carcass ratio for smooth dogfish. A major issue in determining a species specific ratio depends on the fin set used for analysis. Cortes and Neer (2006) and Biery and Pauly (2012) determined a fin-to-carcass ratio for smooth dogfish based on data from Baremore *et al.* and Baremore 2005. These data by I.E Baremore were never published and have not been released to the public; therefore the study cannot be evaluated thoroughly to determine its validity. The purpose of this paper is to provide a range of fin-to-carcass ratios based on fin sets, for smooth dogfish), that can be presented to the public and used by managers to assist in future management decisions.

BACKGROUND

Smooth dogfish are managed in state waters by the Atlantic States Marine Fisheries Commission (ASMFC) Fishery Management Plan for Coastal Sharks (FMP) approved in 2008. Smooth dogfish are not actively managed by NOAA Fisheries even though they were included in Amendment 3 to the 2006 Consolidated Atlantic HMS Fishery Management Plan (HMS FMP) approved in March of 2010 (NMFS 2010). The Spiny Dogfish and Coastal Sharks Management Board (Board) does not set active quotas, but instead follows NOAA Fisheries closures and openings for coastal sharks. Because fishery quotas are set at a harvest level that is estimated to be sustainable based on the stock assessment, the Board is unable to set quotas for smooth dogfish until NOAA Fisheries sets an active quota (ASMFC 2014). NOAA Fisheries will determine an active quota after the initial smooth dogfish stock assessment is complete. In the interim, the Board has specified state-shares (%) of the coastwide quota which will become active when NOAA Fisheries sets the quota.

The ASMFC Coastal Shark FMP has 3 Addenda. Addendum I, approved September 2009, modified the FMP to allow limited smooth dogfish processing at sea (removal of fins from the carcass), removed smooth dogfish recreational possession limits, and removed the two (2) hour gillnet check requirement for commercial fishermen using large mesh gill net (ASMFC 2009b). Addendum II modified the FMP to allow year round smooth dogfish processing at sea, modified the fin-to-carcass ratio, allocated state-shares of the smooth dogfish federal quota and set recreational possession limits (ASMFC 2013b). Addendum III approved in 2013 modified the species groups to ensure consistency with NOAA Fisheries. The addendum also increased the recreational size limit for all hammerhead sharks species to 78" fork length (ASMFC 2013f). Addendum I and II address the fin-to-carcass ratio discussions which is the focus of this paper.

The goal of Addendum I was to remove restrictive management intended for large coastal sharks from the smooth dogfish fishery and to allow fishermen to continue their operations while upholding the conservation measures of the FMP (ASMFC 2014). Smooth dogfish processed at sea had to comply with The Shark Finning Prohibition Act (Act) of 2000 (NMFS 2008). The Act prohibited finning (cutting off the fins and discarding the body at sea) of smooth dogfish and other sharks in the exclusive economic zone (EEZ). The Act also required that the total wet weight of the shark fins cannot exceed 5% of the total dressed weight of shark carcasses found on board a vessel. That 5% ratio has been a concern for many fishermen because of the large fin size compared to the weight of a dressed carcass in smooth dogfish.

The goal of Addendum II was to implement an accurate fin-to-carcass ratio and prevent the quota of smooth dogfish from being harvested in one state, while excluding other states (ASMFC 2014). Addendum II changed the fin-to-carcass ratio for smooth dogfish from 5:95 to 12:88 (wet weight of shark fins to dressed weight of shark carcasses, a 12% fin weight

percentage) to ensure consistency with the Shark Conservation Act (SCA) of 2010 (U. S. Congress 2011). The SCA bans processing-at-sea for all shark species, except smooth dogfish. Senate amendment 4914 (Reid, et al. 2010) added a savings clause onto the bill H.R. 81, that exempted individuals engaged in commercial fishing for smooth dogfish from the SCA. Exempted individuals must be fishing within 50 nautical miles from the baseline of a State, and the individual must hold a valid State commercial fishing license. The SCA with the included amendment passed the Senate on December 20, 2010 and the House on December 21, 2010 and was signed into law by President Barack Obama on January 4, 2011.

ASMFC TC BACKGROUND

The ASMFC Coastal Shark Technical Committee (TC) members reviewed memorandums concerning smooth dogfish fin-to-carcass ratio submitted in July 2009 and September 2009 from North Carolina. The July 2009 memo was not endorsed by the TC because it did not contain the individual weight of fish and the ratio was based on trip ticket data from 2004 through 2009 (ASMFC 2009a, ASMFC 2012). The September 2009 memo included individual weights from 16 fish sampled by the NCDMF staff (Table 2, ASMFC 2013d). The memo determined that the appropriate fin-to-carcass ratio ranged from 9:91 to 11:89. After receiving both of these memorandums, the Board tasked the TC to determine an appropriate fin-to-carcass ratio using commercial processing methods (ASMFC 2013a). This paper summarizes the methods and results from data collected by the North Carolina and New Jersey to satisfy the Board's request. The paper will provide data, collected through documented procedures, to better inform managers of an appropriate species specific fin-to-carcass ratio for smooth dogfish.

MATERIALS AND METHODS

New Jersey's data (NJ12) were collected on October 11, 2012 from a winter ocean trawl stock assessment survey, which uses a stratified random sampling design to collect trawl data from New Jersey coastal waters. The survey area only includes waters adjacent to the New Jersey coastline. Trawl samples are collected with a three-in-one trawl, which is a two-seam trawl constructed of polyethylene twine with forward netting (wings, belly) of 12 cm. (4.7 in.) stretch mesh and rear netting of 8 cm. (3.1 in.) stretch mesh. The codend is 7.6 cm. stretch mesh (3.0 in.) and is lined with 6.4 mm. (0.25 in.) bar mesh liner. The headrope is 25 m. (82 ft.) long and the footrope is 30.5 m. (100 ft.) long. The trawl bridle is 120 ft. long, the top leg consisting of 0.5 in. wire rope and the bottom leg comprised of 0.75 in. wire rope covered with 2 3/8 in. rubber cookies. A 60 ft. groundwire, also made of 0.75 in. wire rope covered with 2 3/8 in. rubber cookies, extends between the bridle and trawl doors. The trawl doors are wooden with steel shoes, 8 ft. x 4.2 ft., and weigh approximately 1,000 lbs each (ASMFC 2013c).

North Carolina's data (NC13) were collected on May 7, 2013 from a commercial ocean gill net. The fishermen randomly selected twenty-five (25) fish, from the days harvest to bring back to the dock, unprocessed. The fishing location, referred to as "Bad Bottom", is three (3) miles off of Hatteras Inlet on the boarder of state and federal waters. The fish were collected from 2700 ft. (823 m.) of monofilament, sink, drifting gill net. The gill net was constructed of 5.5 in. stretched mesh and was 50 bar meshes deep. The vertical fishing depth of the net was 6 m. (20 ft.). North Carolina smooth dogfish fishermen commonly set bundles or shots of 900 ft. (274 m.) monofilament, sink, drifting gill net. The bundles can be tied together and set as a continuous length of net. During net construction 900 ft. of gill net, often segmented in 300 ft. (91 m.) panels is used. Mesh sizes range from 5.5 to 6 in. stretched mesh and the thickness of

monofilament ranges from 0.81 to 0.90 mm. Nets are also constructed 40 - 50 bar meshes deep. Depending on the size of mesh used, the vertical height of the net can range from 16 to 21 ft. (4.8 to 5.6 m.).

COLLECTION

New Jersey trawl samples were collected by towing the net for 20 minutes, timed from the moment the winch brakes are set to stop the deployment of tow wire to the beginning of haulback. Target towing speed is 2.5 – 3.0 knots, or about 2.8 knots. A 20 minute tow generally covers about one nautical mile (1852 m.). Following haulback, the catch is placed into a 4 x 8 ft. sorting table where fishes and macroinvertebrates are sorted by species. The total weight of each species is measured with hanging metric scales and the length of all individuals comprising each species caught, or a representative sample by weight for large catches is measured to the nearest centimeter (cm.). All smooth dogfish retained in this study were randomly removed throughout the day by Marine Fisheries staff following the recording of total dogfish weight for a given trawl. No preference was given to sex or size. Personnel on the vessel reported that the fish collected and retained were representative of size of fish collected throughout survey.

North Carolina's 2013 samples were collected from one (1) commercial gill net set off of Hatteras, North Carolina. The gill net soak duration was approximately three (3) hours and the water depth ranged from 50 to 60 ft. (15 to 18 m.). All smooth dogfish retained by the fishermen were randomly removed throughout the day and no preference was given to sex or size. Once all metrics were collected by NCDMF staff, the dressed carcass and fins were returned to the fishermen. The fish were included on the NCDMF trip ticket generated for that trip being sold to the fish house.

PROCESSING

Commercial fishermen who regularly land smooth dogfish were consulted by NJDEP and NCDMF prior to sample collection and processing. NJDEP took the lead in 2012, consulting with three commercial fishermen on their processing methods and photo documenting the multi-step processing procedures (Appendix A) used for the study (ASMFC 2013c). NCDMF staff talked with smooth dogfish fishermen to verify that their processing procedures were similar to the ones documented in the white paper (ASMFC 2013c) used for procedural replication. Based on conversations with commercial fishermen who regularly land and process smooth dogfish, it was decided that fin removal using a straight cut better represents the practices observed across New Jersey and North Carolina's fisheries.

Straight cuts, directly below the cartilaginous section of the fin, were used to remove the first dorsal (D1) and second dorsal (D2) fins. This is the predominant cut used by NJ and NC fishermen, contacted for the study, for ease and quickness when processing. A small amount of meat remains attached to the fin as a result of this type of cut. The selected cut for pectoral fins was also a straight cut, in line with the angle of the torso and through the fleshy lobe of the fin attachment on the torso. An alternative circular cut, for dorsal and pectoral fins, around the fleshy lobes at the base of each fin resulting in less meat attached to the fin was not selected for this study. The circular cut was not deemed to be a common practice between NC and NJ fishermen, and is a much more time consuming cut. The caudal fin was removed with a cut slightly anterior of the caudal fin. The shark was headed and gutted using a vertical cut from the dorsal (behind the head) to the skin of the ventral side, in line with the posterior gill slit. This cut was a continuous cut that traversed along the color change of the sharks belly flap, terminating anterior of the pelvic fin. This is the most common and efficient cut used to gut the fish and increases ease and speed of processing.

Fork length (mm.) and total weight (kg.) were recorded prior to processing. Each dorsal fin (D1 and D2) was removed via a straight cut and the individual weight of each fin was recorded to the nearest 0.01 kg. The pectoral fins (P) were removed via a straight cut and both fins were recorded as a single combined weight to the nearest 0.01 kg.. The caudal fin was removed via a cut anterior of the caudal fin and the individual weight was recorded to the nearest 0.01 kg.. Following fin removal, the fish was gutted using a continuous cut, starting in line with the posterior gill slit, and terminating anterior of the pelvic fin. The fishes head and entrails were removed, and the carcass was cleaned of spinal bloodlines and additional flesh. Finally, the individual dressed carcass weight (kg.), with only the anal fin attached, was recorded to the nearest 0.01 kg.

The following metrics were collected, fork length (mm.), sex (m/f), round/whole weight (kg.), dressed/carcass weight (kg.), first dorsal weight (kg.), second dorsal weight (kg.), pectoral fin weight (kg.) and caudal fin weight (kg.). Weights were collected using a bench scale with reliability to 0.01 kg. (Table 1). Total fin weights (kg.) and percent carcass weights (%) were then calculated for each individual fish (Table 3).

RESULTS

NJ12 data were collected from 52 fish (Table 7), 23 females and 28 males. Mean was 707.3 mm. (Table 7). Females sampled had a minimum fork length of 545 mm., a maximum fork length of 1060 mm. and a mean fork length of 713.8 mm. (Table 4). Males sampled had a minimum fork length of 548 mm., a maximum fork length of 874 mm., and a mean fork length of 702.8 mm. (Table 4). The mean dressed carcass weight for the study was 0.56 kg. (Table 7) but ranged from 0.53 kg. for males and 0.60 kg. for females (Table 4). Mean percent fin weight to dressed carcass weight D1, D2, P, C fin set was 14.18% (Table 7) but ranged from13.91% for females and 14.39% for males (Table 4). Mean percent fin weight to dressed carcass weight D1, D2, P fin set was 8.67% (Table 7) but ranged from 8.50% for females and 8.80% for males (Table 4). Mean percent fin weight to dressed carcass weight D1, D2 fin set was 7.51% (Table 7) but ranged from 7.42% for females and 7.58% for males (Table 4).

NC13 data were collected from 25 fish (Table 5), 4 females and 21 males. Mean was 890.2 mm (Table 7). Females sampled had a minimum fork length of 830 mm, a maximum fork length of 1110 mm. and a mean fork length of 948.8 mm (Table 5). Males sampled had a minimum fork length of 779 mm., a maximum of 1030 mm. and a mean fork length of 879.0 mm. (Table 5) . NC13 mean dressed carcass weight was 1.68 kg. (Table 7) but ranged from 2.15 kg. for females and 1.58 kg. for males (Table 5). Mean percent fin weight to dressed carcass weight D1, D2, P, C fin set was 13.46% (Table 7)but ranged from13.86% for females and 13.38% for males (Table 5). Mean percent fin weight to dressed carcass weight D1, D2, P fin set was 9.48% (Table 7) but ranged from 10.08% for females and 9.36% for males (Table 5). Mean percent fin weight to dressed carcass weight D1, D2 fin set was 8.28% (Table 7) but ranged from 8.68% for females and 8.20% for males (Table 5).

A total of 77 fish were sampled for the studies (Table 8), 27 females and 50 males (Table 6). Females had a minimum fork length of 545 mm, a maximum fork length of 1110 mm. and a mean fork length of 748.6 mm. (Table 6). Males had a minimum fork length of 548 mm, a maximum fork length of 1030 mm. and a mean fork length of 776.4 mm. (Table 6). Mean dressed carcass weight was 0.92 kg. (Table 8) and ranged from 0.84 kg. for females and 0.97 kg. for males (Table 6). Mean percent fin weight to dressed carcass weight for D1, D2, P, C fin set was 13.94% (Table 8) but ranged from13.90% for females and 13.97% for males (Table 6). Mean percent fin weight to dressed carcass weight D1, D2, P fin set was 8.93% (Table 8) but ranged from 8.74% for females and 9.04% for males (Table 6). Mean percent fin weight to

dressed carcass weight D1, D2 fin set was 7.76% (Table 8) but ranged from 7.60% for females and 7.84% for males (Table 6).

DISCUSSION

Fin sets kept in the two states differ; North Carolina fishermen retain the D1 and D2 fins, along with the P fins. Most New Jersey fishermen do not retain the D2 fins. The fin set harvesting practices can change depending on market demands. Both states retain the caudal fins, culled separately. All fins were cut and weighed separately for analysis.

New Jersey noted that smooth dogfish from their study were a smaller size than marketable fish retained in commercial fisheries or caught in their spring trawl survey (ASMFC 2013c). This is apparent in North Carolina mean fork length and dressed carcass weights (890.2 mm. and 1.68 kg.) compared to New Jersey's (707.7 mm. and 0.56 kg.). However, there was no relationship between the size of the fish (fork length or dressed weight) and the fin-to-carcass ratio when comparing the two data sets mean percent fin weight to dressed carcass weight (Figures 1-3).

CONCLUSION

The cumulative data on 77 dogfish analyzed in this paper indicate that an appropriate fin weight to dressed carcass weight ratio for smooth dogfish can range from 7.76% to 13.94% depending on the fin set evaluated (Table 5). Fin sets including the caudal fin are highest, mean sum D1, D2, P, C of 0.13 kg. The mean fin weight to dressed carcass percentage for fin sets including the caudal is 13.94% for all 77 fish (Table 5). When the fin set excludes the caudal but includes the second dorsal fin, mean sum D1, D2, P of 0.08 kg. The mean fin weight to dressed carcass percentage is reduced to 8.93% for all 77 fish (Table 5). If the fin set contains only the first dorsal and the pectoral fin, mean sum D1, P of 0.07 kg., the mean fin weight to dressed carcass percentage is 7.76%.

This paper presents a robust sample size (77 individuals, 65% male, 35% female) of fish harvested from both independent and dependent sampling. The data suggest proportional growth for fins and body (Figures 1-3). The fin-to-carcass ratios for each fin set are closely related and show no relationship between fork length, sex or weight (Tables 4-8). The data presented within this paper support a species specific fin-to-carcass ratio for smooth dogfish ranging from 8:92 to 14:86 depending on the fin set retained.

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Table 1. Raw data collected by NCDMF May 7, 2013 and NJDEP October 11, 2012 for fin-to-carcass analysis

D1 = 1st dorsal ; D2 = 2nd Dorsal; P = Pectoral; C = Caudal										
n	State/Year	Fork Length (mm.)	Sex (M/F)	Round / Whole (kg.)	Dressed / Carcass (kg.)	D1 (kg.)	D2 (kg.)	P (kg.)	C (kg.)	Total (kg.)
1	NC13	830	F	2.53	1.23	0.03	0.02	0.08	0.05	0.18
2	NC13	850	F	2.79	1.38	0.04	0.02	0.07	0.06	0.19
3	NC13	1110	F	10.15	3.57	0.08	0.05	0.23	0.13	0.49
4	NC13	1005	F	7.41	2.63	0.06	0.03	0.18	0.08	0.35
5	NC13	879	M	3.37	1.69	0.04	0.02	0.08	0.06	0.20
6	NC13	900	M	3.47	1.63	0.04	0.02	0.08	0.06	0.20
7	NC13	891	M	3.33	1.50	0.04	0.02	0.08	0.05	0.19
8	NC13	869	M	3.31	1.59	0.05	0.02	0.08	0.07	0.22
9	NC13	910	M	3.25	1.59	0.03	0.02	0.08	0.06	0.19
10	NC13	833	M	2.30	1.17	0.03	0.01	0.06	0.05	0.15
11	NC13	830	M	2.84	1.40	0.04	0.01	0.07	0.06	0.18
12	NC13	904	M	3.36	1.68	0.04	0.02	0.09	0.07	0.22
13	NC13	779	M	2.29	1.09	0.03	0.01	0.06	0.05	0.15
14	NC13	881	M	3.90	1.79	0.04	0.02	0.11	0.06	0.23
15	NC13	885	M	2.98	1.38	0.03	0.01	0.08	0.06	0.18
16	NC13	858	M	2.92	1.33	0.03	0.02	0.08	0.06	0.19
17	NC13	1030	M	9.06	3.22	0.09	0.04	0.20	0.11	0.44
18	NC13	888	M	3.28	1.53	0.05	0.04	0.10	0.06	0.25
19	NC13	895	M	3.28	1.58	0.05	0.02	0.09	0.05	0.21
20	NC13	908	M	3.38	1.60	0.05	0.02	0.10	0.06	0.23
21	NC13	862	M	2.80	1.33	0.03	0.01	0.08	0.05	0.17
22	NC13	922	M	3.99	1.87	0.05	0.02	0.12	0.08	0.27
23	NC13	825	M	2.66	1.23	0.03	0.01	0.08	0.06	0.18
24	NC13	820	M	2.74	1.27	0.02	0.01	0.07	0.06	0.16
25	NC13	890	M	3.63	1.61	0.04	0.02	0.09	0.07	0.22
26	NJ12	688	F	1.20	0.56	0.02	0.01	0.03	0.03	0.08
27	NJ12	690	F	1.19	0.55	0.01	0.01	0.03	0.03	0.08
28	NJ12	738	F	1.44	0.64	0.02	0.01	0.03	0.04	0.10
29	NJ12	546	F	0.67	0.29	0.01	0.00	0.02	0.02	0.04
30	NJ12	743	F	1.41	0.64	0.02	0.01	0.03	0.04	0.09
31	NJ12	715	F	1.32	0.61	0.02	0.01	0.03	0.03	0.09
32	NJ12	716	F	1.34	0.58	0.02	0.01	0.03	0.03	0.09
33	NJ12	545	F	0.62	0.27	0.01	0.00	0.01	0.02	0.04
34	NJ12	711	F	1.25	0.58	0.01	0.00	0.03	0.03	0.08
35	NJ12	735	F	1.43	0.68	0.01	0.01	0.03	0.04	0.09
36	NJ12	723	F	1.18	0.53	0.01	0.01	0.02	0.03	0.07
37	NJ12	691	F	1.16	0.53	0.01	0.00	0.03	0.03	0.07
38	NJ12	735	F	1.29	0.59	0.02	0.01	0.03	0.03	0.09
39	NJ12	671	F	1.04	0.48	0.01	0.01	0.02	0.03	0.07
40	NJ12	734	F	1.33	0.60	0.01	0.01	0.03	0.04	0.08
41	NJ12	714	F	1.29	0.58	0.01	0.01	0.03	0.03	0.08

Table 1. Continued

D1 = 1st dorsal ; D2 = 2nd Dorsal; P = Pectoral; C = Caudal										
n	State/Year	Fork Length (mm.)	Sex (M/F)	Round / Whole (kg.)	Dressed / Carcass (kg.)	D1 (kg.)	D2 (kg.)	P (kg.)	C (kg.)	Total (kg.)
42	NJ12	1060	F	4.37	1.81	0.04	0.02	0.08	0.09	0.23
43	NJ12	668	F	0.98	0.40	0.01	0.01	0.03	0.03	0.07
44	NJ12	839	F	1.91	0.90	0.02	0.01	0.03	0.03	0.09
45	NJ12	691	F	1.27	0.57	0.01	0.00	0.03	0.03	0.07
46	NJ12	698	F	1.17	0.52	0.01	0.01	0.03	0.03	0.07
47	NJ12	668	F	0.98	0.48	0.01	0.01	0.03	0.03	0.07
48	NJ12	698	F	1.13	0.50	0.01	0.01	0.03	0.03	0.08
49	NJ12	684	M	1.08	0.50	0.01	0.01	0.03	0.03	0.07
50	NJ12	705	M	1.08	0.52	0.01	0.01	0.03	0.03	0.08
51	NJ12	551	M	0.63	0.29	0.01	0.01	0.01	0.02	0.04
52	NJ12	874	M	2.13	0.94	0.02	0.01	0.05	0.05	0.13
53	NJ12	548	M	0.58	0.27	0.01	0.01	0.01	0.01	0.04
54	NJ12	704	M	1.18	0.55	0.02	0.01	0.03	0.03	0.08
55	NJ12	710	M	1.18	0.55	0.02	0.01	0.03	0.03	0.08
56	NJ12	554	M	0.57	0.24	0.01	0.00	0.02	0.02	0.05
57	NJ12	705	M	1.14	0.54	0.01	0.01	0.03	0.03	0.07
58	NJ12	735	M	1.18	0.52	0.01	0.01	0.03	0.03	0.08
59	NJ12	677	M	1.00	0.47	0.02	0.01	0.02	0.02	0.07
60	NJ12	732	M	1.35	0.65	0.01	0.01	0.03	0.04	0.09
61	NJ12	729	M	1.19	0.55	0.01	0.01	0.03	0.03	0.08
62	NJ12	743	M	1.36	0.63	0.02	0.01	0.03	0.03	0.09
63	NJ12	710	M	1.14	0.52	0.01	0.01	0.03	0.03	0.08
64	NJ12	733	M	1.33	0.60	0.01	0.01	0.03	0.03	0.08
65	NJ12	745	M	1.35	0.62	0.01	0.01	0.03	0.04	0.09
66	NJ12	784	M	1.39	0.66	0.02	0.00	0.03	0.04	0.08
67	NJ12	696	M	1.07	0.48	0.01	0.01	0.03	0.02	0.07
68	NJ12	730	M	1.11	0.51	0.01	0.01	0.03	0.03	0.08
69	NJ12	713	M	1.20	0.57	0.01	0.01	0.03	0.03	0.08
70	NJ12	682	M	1.11	0.50	0.01	0.01	0.03	0.03	0.07
71	NJ12	807	M	1.58	0.72	0.02	0.01	0.04	0.04	0.10
72	NJ12	742	M	1.30	0.61	0.01	0.01	0.03	0.03	0.09
73	NJ12	692	M	1.06	0.47	0.01	0.01	0.03	0.03	0.07
74	NJ12	632	M	0.82	0.39	0.01	0.00	0.02	0.02	0.06
75	NJ12	716	M	1.19	0.58	0.01	0.01	0.03	0.03	0.08
76	NJ12	676	M	1.04	0.48	0.01	0.00	0.03	0.03	0.07
77	NJ12	653	M	0.94	0.42	0.01	0.01	0.02	0.03	0.06

Table 2. NCDMF September 2009 memo data

D1 = 1st dorsal ; D2 = 2nd Dorsal; P = Pectoral							
n	State/Year	Fork Length (mm.)	Sex (M/F)	Round / Whole (kg.)	Dressed / Carcass (kg.)	D1, D2, P Sum (kg.)	% Carcass D1, D2, P
1	NC09	950	F	4.97	1.98	0.18	9.09
2	NC09	900	F	4.48	1.83	0.19	10.38
3	NC09	950	F	4.35	1.85	0.18	9.73
4	NC09	940	F	4.45	1.76	0.17	9.66
5	NC09	1000	F	5.34	2.28	0.22	9.65
6	NC09	960	F	4.91	1.92	0.18	9.38
7	NC09	910	F	4.48	1.75	0.18	10.29
8	NC09	1110	F	7.76	3.16	0.28	8.86
9	NC09	1050	F	6.23	2.68	0.23	8.58
10	NC09	940	F	4.55	1.80	0.19	10.56
11	NC09	1010	F	5.78	2.44	0.21	8.61
12	NC09	960	F	4.96	2.15	0.20	9.30
13	NC09	1070	F	7.19	2.60	0.28	10.77
14	NC09	1010	F	5.35	2.22	0.25	11.26
15	NC09	890	F	3.64	1.54	0.15	9.74
16	NC09	1000	F	5.53	2.28	0.20	8.77

Min Fork Length (mm.)	Max Fork Length (mm.)	Mean Fork Length (mm.)	Mean Round / Whole (kg.)	Mean Dressed / Carcass (kg.)	Mean D1, D2, P Sum (kg.)	Mean % Fin D1, D2, P
890	1110	978.1	5.25	2.14	0.21	9.66

Table 3. NCDMF, NJDEP and NCDMF 2009 fin-to-carcass sum fin set weight (kg.) and percent (%) carcass

D1 = 1st dorsal ; D2 = 2nd Dorsal; P = Pectoral; C = Caudal										
n	State/Year	Fork Length (mm.)	Sex (M/F)	Dressed / Carcass (kg.)	D1, D2, P, C Sum (kg.)	% Carcass D1, D2, P, C	D1, D2, P Sum (kg.)	% Carcass D1, D2, P	D1, P Sum (kg.)	% Carcass D1, P
1	NC13	830	F	1.23	0.18	14.6	0.13	10.6	0.11	8.9
2	NC13	850	F	1.38	0.19	13.8	0.13	9.4	0.11	8.0
3	NC13	1110	F	3.57	0.49	13.7	0.36	10.1	0.31	8.7
4	NC13	1005	F	2.63	0.35	13.3	0.27	10.3	0.24	9.1
5	NC13	879	M	1.69	0.20	11.8	0.14	8.3	0.12	7.1
6	NC13	900	M	1.63	0.20	12.3	0.14	8.6	0.12	7.4
7	NC13	891	M	1.50	0.19	12.7	0.14	9.3	0.12	8.0
8	NC13	869	M	1.59	0.22	13.8	0.15	9.4	0.13	8.2
9	NC13	910	M	1.59	0.19	11.9	0.13	8.2	0.11	6.9
10	NC13	833	M	1.17	0.15	12.8	0.10	8.5	0.09	7.7
11	NC13	830	M	1.40	0.18	12.9	0.12	8.6	0.11	7.9
12	NC13	904	M	1.68	0.22	13.1	0.15	8.9	0.13	7.7
13	NC13	779	M	1.09	0.15	13.8	0.10	9.2	0.09	8.3
14	NC13	881	M	1.79	0.23	12.8	0.17	9.5	0.15	8.4
15	NC13	885	M	1.38	0.18	13.0	0.12	8.7	0.11	8.0
16	NC13	858	M	1.33	0.19	14.3	0.13	9.8	0.11	8.3
17	NC13	1030	M	3.22	0.44	13.7	0.33	10.2	0.29	9.0
18	NC13	888	M	1.53	0.25	16.3	0.19	12.4	0.15	9.8
19	NC13	895	M	1.58	0.21	13.3	0.16	10.1	0.14	8.9
20	NC13	908	M	1.60	0.23	14.4	0.17	10.6	0.15	9.4
21	NC13	862	M	1.33	0.17	12.8	0.12	9.0	0.11	8.3
22	NC13	922	M	1.87	0.27	14.4	0.19	10.2	0.17	9.1
23	NC13	825	M	1.23	0.18	14.6	0.12	9.8	0.11	8.9
24	NC13	820	M	1.27	0.16	12.6	0.10	7.9	0.09	7.1
25	NC13	890	M	1.61	0.22	13.7	0.15	9.3	0.13	8.1
26	NJ12	688	F	0.56	0.08	14.4	0.05	9.4	0.05	8.3
27	NJ12	690	F	0.55	0.08	13.7	0.05	8.7	0.04	7.8
28	NJ12	738	F	0.64	0.10	15.0	0.06	9.4	0.05	8.0
29	NJ12	546	F	0.29	0.04	15.3	0.03	9.8	0.02	8.4
30	NJ12	743	F	0.64	0.09	14.0	0.05	8.1	0.05	7.3
31	NJ12	715	F	0.61	0.09	15.0	0.06	10.0	0.05	8.2
32	NJ12	716	F	0.58	0.09	15.2	0.06	9.7	0.05	8.3
33	NJ12	545	F	0.27	0.04	14.2	0.02	8.2	0.02	7.5
34	NJ12	711	F	0.58	0.08	13.1	0.05	7.9	0.04	7.2
35	NJ12	735	F	0.68	0.09	13.2	0.05	7.8	0.05	6.7
36	NJ12	723	F	0.53	0.07	12.2	0.04	7.1	0.03	5.8
37	NJ12	691	F	0.53	0.07	13.8	0.04	7.9	0.04	7.2
38	NJ12	735	F	0.59	0.09	14.9	0.06	10.0	0.05	8.4
39	NJ12	671	F	0.48	0.07	13.6	0.04	8.2	0.03	7.1
40	NJ12	734	F	0.60	0.08	13.7	0.05	7.8	0.04	7.0
41	NJ12	714	F	0.58	0.08	14.5	0.05	9.3	0.05	7.9

Table 3. Continued

D1 = 1st dorsal ; D2 = 2nd Dorsal; P = Pectoral; C = Caudal										
n	State/Year	Fork Length (mm.)	Sex (M/F)	Dressed / Carcass (kg.)	D1, D2, P, C Sum (kg.)	% Carcass D1, D2, P, C	D1, D2, P Sum (kg.)	% Carcass D1, D2, P	D1, P Sum (kg.)	% Carcass D1, P
42	NJ12	1060	F	1.81	0.23	12.5	0.14	7.6	0.12	6.7
43	NJ12	668	F	0.40	0.07	17.6	0.04	10.8	0.04	9.6
44	NJ12	839	F	0.90	0.09	9.8	0.06	6.1	0.05	5.4
45	NJ12	691	F	0.57	0.07	11.5	0.04	6.4	0.03	5.8
46	NJ12	698	F	0.52	0.07	13.6	0.04	7.6	0.04	6.7
47	NJ12	668	F	0.48	0.07	13.5	0.04	8.1	0.03	7.1
48	NJ12	698	F	0.50	0.08	15.6	0.05	9.6	0.04	8.2
49	NJ12	684	M	0.50	0.07	14.3	0.05	9.0	0.04	7.4
50	NJ12	705	M	0.52	0.08	15.1	0.05	9.5	0.04	8.1
51	NJ12	551	M	0.29	0.04	14.2	0.03	9.0	0.02	7.3
52	NJ12	874	M	0.94	0.13	13.7	0.08	8.4	0.07	7.5
53	NJ12	548	M	0.27	0.04	14.8	0.03	10.4	0.02	8.1
54	NJ12	704	M	0.55	0.08	15.0	0.05	9.0	0.04	7.8
55	NJ12	710	M	0.55	0.08	14.6	0.05	9.2	0.04	7.8
56	NJ12	554	M	0.24	0.05	18.9	0.03	11.5	0.03	10.2
57	NJ12	705	M	0.54	0.07	13.6	0.05	8.5	0.04	7.5
58	NJ12	735	M	0.52	0.08	14.6	0.05	8.6	0.04	7.5
59	NJ12	677	M	0.47	0.07	14.6	0.04	9.4	0.04	8.4
60	NJ12	732	M	0.65	0.09	13.6	0.05	8.0	0.04	6.8
61	NJ12	729	M	0.55	0.08	14.7	0.05	8.4	0.04	7.1
62	NJ12	743	M	0.63	0.09	13.5	0.05	8.1	0.04	6.8
63	NJ12	710	M	0.52	0.08	14.5	0.05	9.2	0.04	8.1
64	NJ12	733	M	0.60	0.08	13.7	0.05	8.5	0.04	7.4
65	NJ12	745	M	0.62	0.09	13.8	0.05	8.1	0.04	7.0
66	NJ12	784	M	0.66	0.08	12.8	0.05	7.3	0.04	6.7
67	NJ12	696	M	0.48	0.07	13.9	0.04	8.9	0.04	7.5
68	NJ12	730	M	0.51	0.08	15.4	0.05	9.0	0.04	7.6
69	NJ12	713	M	0.57	0.08	13.3	0.05	8.0	0.04	6.7
70	NJ12	682	M	0.50	0.07	14.7	0.04	8.7	0.04	7.8
71	NJ12	807	M	0.72	0.10	14.0	0.06	8.6	0.05	7.3
72	NJ12	742	M	0.61	0.09	14.5	0.06	9.1	0.05	7.8
73	NJ12	692	M	0.47	0.07	14.8	0.04	8.5	0.04	7.4
74	NJ12	632	M	0.39	0.06	14.7	0.03	8.7	0.03	7.7
75	NJ12	716	M	0.58	0.08	13.0	0.04	7.4	0.04	6.4
76	NJ12	676	M	0.48	0.07	14.7	0.05	9.5	0.04	8.6
77	NJ12	653	M	0.42	0.06	14.5	0.04	8.6	0.03	7.4

Table 4. NJ12 minimum fork length (mm.), maximum fork length (mm.), mean fork length (mm.), mean dressed carcass (kg.), mean D1, D1, P, C sum (kg.), mean percent (%) carcass weight D1, D2, P, C, mean D1, D2, P sum (kg.), mean percent (%) carcass weight D1, D2, P, mean D1, P sum (kg.) and mean percent (%) carcass weight D1, P for females and males.

NJ12 Mean Female and Male D1 = 1st dorsal ; D2 = 2nd Dorsal; P = Pectoral; C = Caudal											
n	Sex	Min Fork Length (mm.)	Max Fork Length (mm.)	Mean Fork Length (mm.)	Mean Dressed / Carcass (kg.)	Mean D1, D2, P, C Sum (kg.)	Mean % Fin D1, D2, P, C	Mean D1, D2, P Sum (kg.)	Mean % Fin D1, D2, P	Mean D1, P Sum (kg.)	Mean % Fin D1, P
23	F	545	1060	713.8	0.60	0.08	13.91	0.05	8.50	0.04	7.42
28	M	548	874	702.8	0.53	0.08	14.39	0.05	8.80	0.04	7.58

Table 5. NC13 minimum fork length (mm.), maximum fork length (mm.), mean fork length (mm.), mean dressed carcass (kg.), mean D1, D1, P, C sum (kg.), mean percent (%) carcass weight D1, D2, P, C, mean D1, D2, P sum (kg.), mean percent (%) carcass weight D1, D2, P, mean D1, P sum (kg.) and mean percent (%) carcass weight D1, P for females and males.

NC13 Mean Female and Male D1 = 1st dorsal ; D2 = 2nd Dorsal; P = Pectoral; C = Caudal											
n	Sex	Min Fork Length (mm.)	Max Fork Length (mm.)	Mean Fork Length (mm.)	Mean Dressed / Carcass (kg.)	Mean D1, D2, P, C Sum (kg.)	Mean % Fin D1, D2, P, C	Mean D1, D2, P Sum (kg.)	Mean % Fin D1, D2, P	Mean D1, P Sum (kg.)	Mean % Fin D1, P
4	F	830	1110	948.8	2.20	0.30	13.86	0.22	10.08	0.19	8.68
21	M	779	1030	879.0	1.58	0.21	13.38	0.15	9.36	0.13	8.20

Table 6. Combined mean NJ12 and NC13 minimum fork length (mm.), maximum fork length (mm.), mean fork length (mm.), mean dressed carcass (kg.), mean D1, D1, P, C sum (kg.), mean percent (%) carcass weight D1, D2, P, C, mean D1, D2, P sum (kg.), mean percent (%) carcass weight D1, D2, P, mean D1, P sum (kg.) and mean percent (%) carcass weight D1, P for females and males.

Combined Mean NJ12/NC13 Female and Male D1 = 1st dorsal ; D2 = 2nd Dorsal; P = Pectoral; C = Caudal											
n	Sex	Min Fork Length (mm.)	Max Fork Length (mm.)	Mean Fork Length (mm.)	Mean Dressed / Carcass (kg.)	Mean D1, D2, P, C Sum (kg.)	Mean % Fin D1, D2, P, C	Mean D1, D2, P Sum (kg.)	Mean % Fin D1, D2, P	Mean D1, P Sum (kg.)	Mean % Fin D1, P
27	F	545	1110	748.6	0.84	0.11	13.90	0.08	8.74	0.07	7.60
50	M	548	1030	776.4	0.97	0.13	13.97	0.09	9.04	0.08	7.84

Table 7. NJ12 and NC13 minimum fork length (mm.), maximum fork length (mm.), mean fork length (mm.), mean dressed carcass (kg.), mean D1, D1, P, C sum (kg.), mean percent (%) carcass weight D1, D2, P, C, mean D1, D2, P sum (kg.), mean percent (%) carcass weight D1, D2, P, mean D1, P sum (kg.) and mean percent (%) carcass weight D1, P

Mean NJ12 and NC13 D1 = 1st dorsal ; D2 = 2nd Dorsal; P = Pectoral; C = Caudal											
n	State/Year	Min Fork Length (mm.)	Max Fork Length (mm.)	Mean Fork Length (mm.)	Mean Dressed / Carcass (kg.)	Mean D1, D2, P, C Sum (kg.)	Mean % Fin D1, D2, P, C	Mean D1, D2, P Sum (kg.)	Mean % Fin D1, D2, P	Mean D1, P Sum (kg.)	Mean % Fin D1, P
52	NJ12	545	1060	707.3	0.56	0.08	14.18	0.05	8.67	0.04	7.51
25	NC13	779	1110	890.2	1.68	0.23	13.46	0.16	9.48	0.14	8.28

Table 8. NJ12/NC13 minimum fork length (mm.), maximum fork length (mm.), mean fork length (mm.), mean dressed carcass (kg.), mean D1, D1, P, C sum (kg.), mean percent (%) carcass weight D1, D2, P, C, mean D1, D2, P sum (kg.), mean percent (%) carcass weight D1, D2, P, mean D1, P sum (kg.) and mean percent (%) carcass weight D1, P

Combined Mean for NJ12/NC13 (NJ12 and NC13) D1 = 1st dorsal ; D2 = 2nd Dorsal; P = Pectoral; C = Caudal											
n	State/Year	Min Fork Length (mm.)	Max Fork Length (mm.)	Mean Fork Length (mm.)	Mean Dressed / Carcass (kg.)	Mean D1, D2, P, C Sum (kg.)	Mean % Fin D1, D2, P, C	Mean D1, D2, P Sum (kg.)	Mean % Fin D1, D2, P	Mean D1, P Sum (kg.)	Mean % Fin D1, P
77	NJ12/NC13	545	1110	766.7	0.92	0.13	13.94	0.08	8.93	0.07	7.76

Figure 1. NJ12 and NC13 (n=77) percent (%) carcass for D1, D2, P, C fin set as a function of dressed carcass weight (kg.) and fork length (mm.).

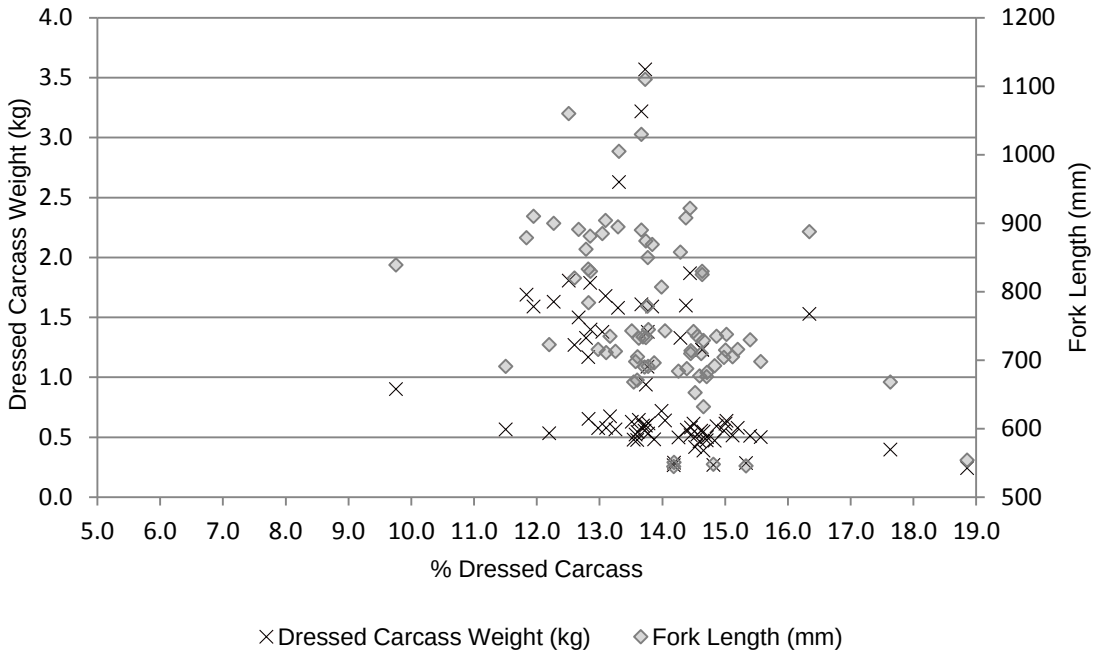


Figure 2. NJ12 and NC13 (n=77) percent (%) carcass for D1, D2, P fin set as a function of dressed carcass weight (kg.) and fork length (mm.).

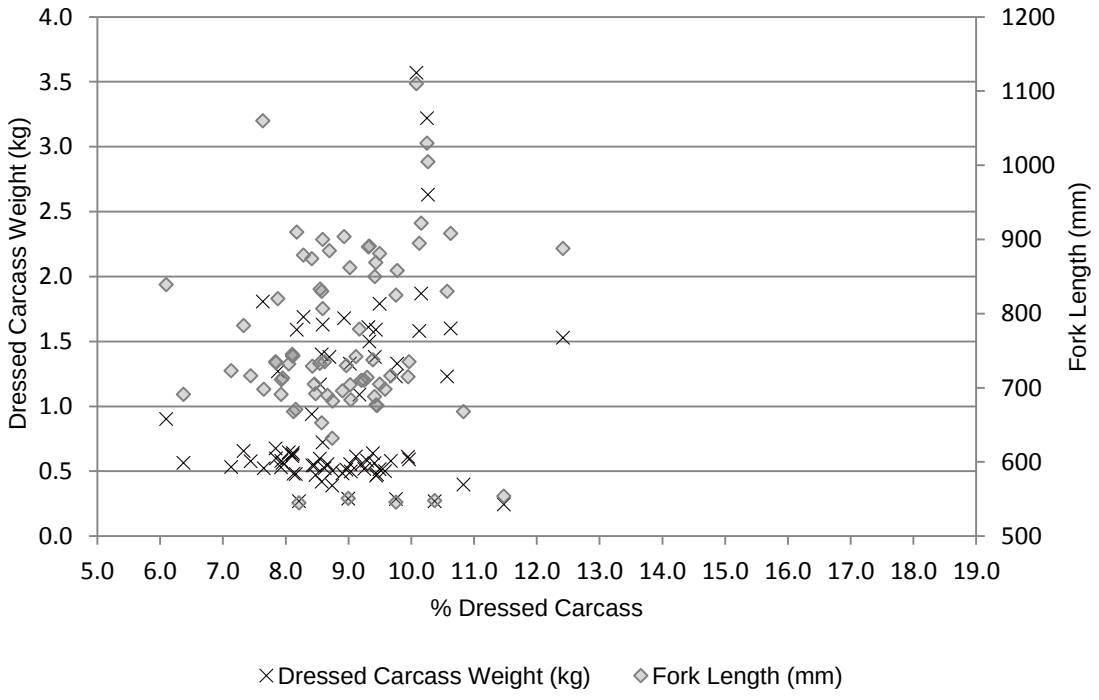
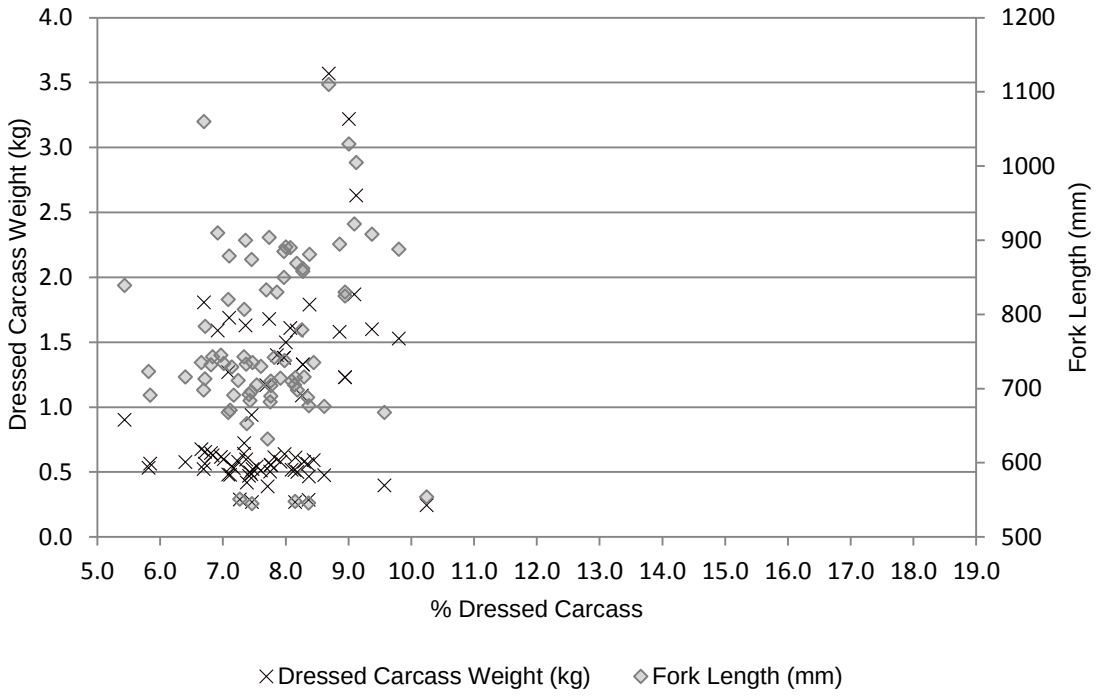


Figure 3. NJ12 and NC13 (n=77) percent (%) carcass for D1, D2 fin set as a function of dressed carcass weight (kg.) and fork length (mm.).



APPENDIX A

This appendix outlines the methods used to process smooth dogfish. Figure 1 shows the fins of smooth dogfish and the abbreviations of each fin.

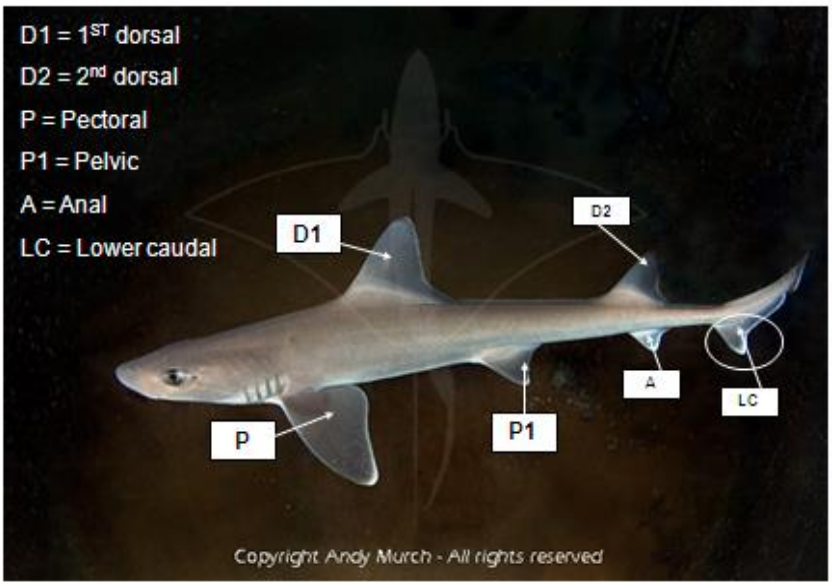


Figure 1. Fin Identification and Codes (Note: For this study C=Upper and lower caudal.)

The first step of processing requires the removal of the fins. Straight cuts (Figure 3) below the cartilaginous section of the fin, were used to remove the first dorsal (D1) and second dorsal (D2). A small amount of meat remains attached to the fin as a result of this type of cut.

Figure 2. Smooth dogfish before processing recording fork length (mm.) and collecting round/whole weight (kg.)

Figure 3. Straight cut of the dorsal fin. Cut occurs immediately below cartilage.

Figure 4. Alternative circular cut, not selected for use in this study, and not used by NJ and NC fishermen consulted for the study.

An alternative circular cut, for dorsal and pectoral fins, around the fleshy lobes at the base of each fin resulting in less meat attached to the fin was not selected for this study (Figure 4). The circular cut was not deemed to be a common practice between NC and NJ fishermen, and is a much more time consuming cut.

Straight cuts were also used to remove the pectoral fins (Figure 5 and 6). These cuts occur in line with the angle of the torso and through the fleshy lobe of the fin attachment on the torso, to account for the angle of the shark torso.

Figure 5. Straight cut of the pectoral fin.

Figure 6. The pectoral fin after it has been removed, using a straight cut.

The caudal fin was removed with a cut slightly anterior of the caudal fin (Figure 7). The shark's head was removed and it was gutted using a vertical cut from the dorsal to the skin of the ventral side, in line with the posterior gill slit (Figure 8). Figure 9 shows the marketable portions of the dogfish after processing is complete.

Figure 7. Caudal fin removal.

Figure 8. Removal of head and guts.

Figure 9. Processed log and straight cuts of D1, D2, P and caudal fin (Note, NJ12 fishermen do not retain the D2 for sale). These are the marketable portions of the smooth dogfish.